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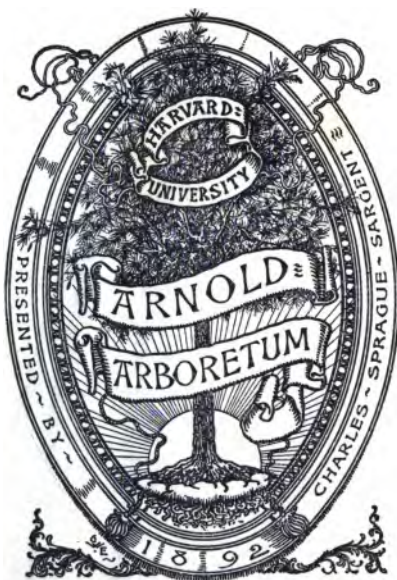
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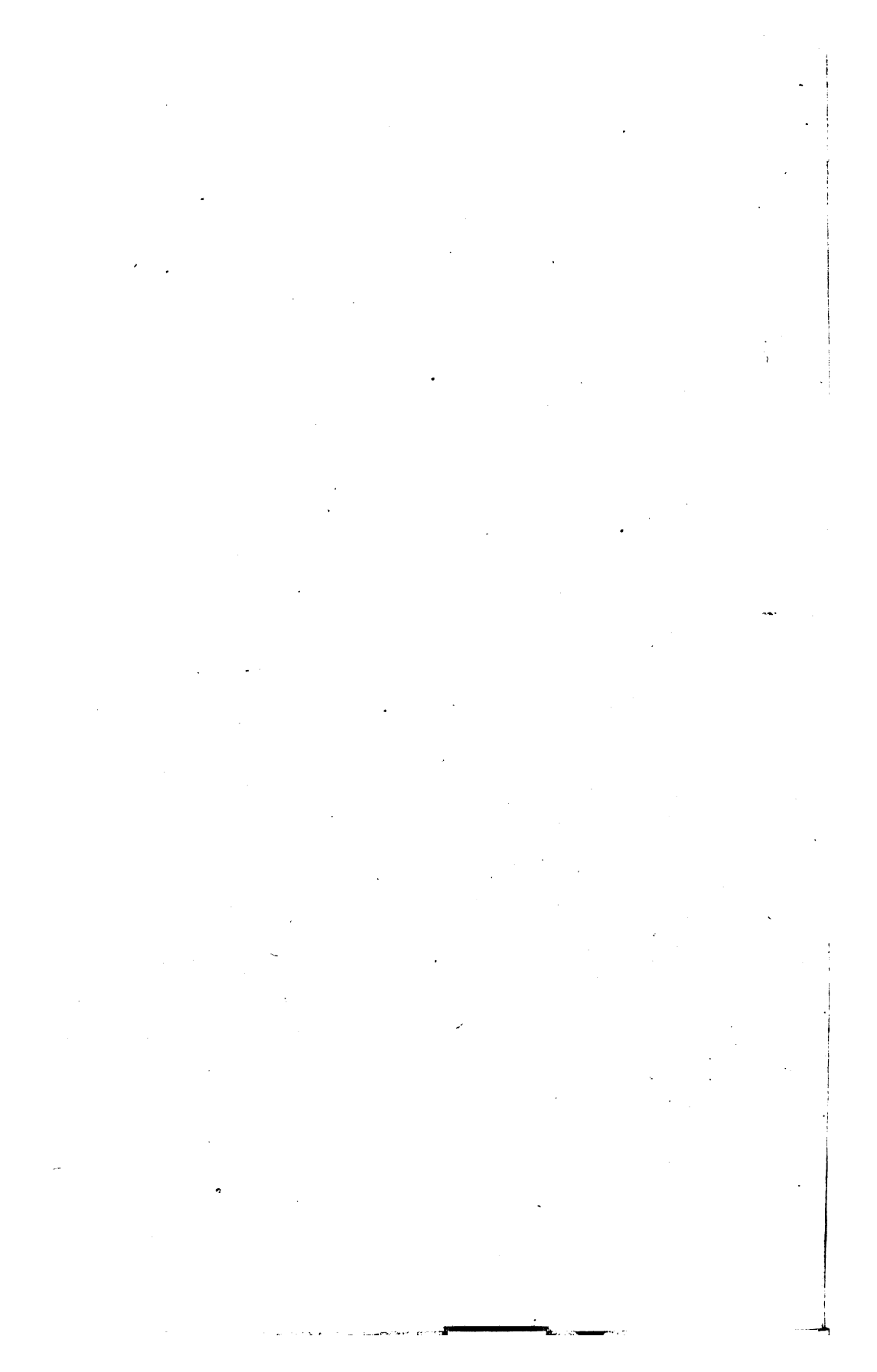
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U. S. DEPARTMENT OF AGRICULTURE, *June 25*

DIVISION OF FORESTRY.

GIFFORD PINCHOT, FORESTER.

PRACTICAL TREE PLANTING

IN

OPERATION.

BY

J. W. TOUMEY,

SUPERINTENDENT OF TREE PLANTING.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

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Apr. 1908
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LETTER OF TRANSMITTAL

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF FORESTRY,
Washington, D. C., March 26, 1900.

SIR: I have the honor to transmit herewith a report entitled "Practical Tree Planting in Operation," prepared by J. W. Toumey, superintendent of tree planting in this Division, and to recommend its publication as Bulletin No. 27 of the Division of Forestry. Credit should be given W. L. Hall, assistant superintendent of tree planting, as the field work upon which the report is based was done chiefly by him.

This report describes the practical working of the cooperation with tree planters begun by this Division in July, 1899, under the provisions of Circular 22, and, in addition, it describes the results of successful planting in the past, both for general and for special purposes. In a word, the report shows by actual examples the method pursued by the Division in assisting tree planters, and its probable results.

Respectfully,

GIFFORD PINCHOT,
Forester.

Hon. JAMES WILSON,
Secretary of Agriculture.

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PRACTICAL TREE-PLANTING IN OPERATION.

INTRODUCTION.

In July, 1899, the Division of Forestry issued Circular No. 22, concisely describing a plan of cooperation by which practical assistance is offered to persons desiring to establish woodlots, shelterbelts, windbreaks, and other plantations of forest trees. Under the provisions of this circular the Division is sending expert tree planters to examine the land owned by persons who request its cooperation, so far as the present resources of the Division will permit.

During the months of October, November, and December, 1899, applicants were visited in Minnesota, North Dakota, Nebraska, Kansas, Oklahoma, and Texas. As a result of the examinations thirty-three working plans were made and are being put into execution. Each of these working plans is based upon the special needs of a particular farm, and is prepared after a careful examination of the farm in question.

TREE-PLANTING AGREEMENT.

The tree-planting agreement which was published in Circular No. 22, and which is still in force with few modifications, is as follows:

WASHINGTON, D. C., ———, ———.

The Department of Agriculture of the United States and ——— of ———, county of ———, State of ———, mutually agree as follows:

1. The Department of Agriculture, in pursuance of investigations in forestry and in order to disseminate a knowledge of improved ways of planting and developing forest plantations, woodlots, shelterbelts, and windbreaks, shall, after personal study on the ground by its agents, prepare a plan for planting and caring for a forest plantation, woodlot, shelterbelt, or windbreak, on ——— acres of land of the said ———, situated and described as follows: ——— town of ———, county of ———, State of ———.

2. The said plan shall be prepared for the purpose of promoting and increasing the present value and usefulness of said land to its owner and to develop and perpetuate a plantation of forest trees upon it.

3. Upon the completion of the said plan and its acceptance by the said ———, the Department of Agriculture shall supervise the execution thereof so far as may be necessary.

4. The Department of Agriculture shall not furnish seeds and trees, nor participate in any degree in the expenses of planting and caring for said forest plantation, woodlot, shelterbelt, or windbreak, nor share in any profit which may arise from its growth.

5. The Department of Agriculture shall render all services under this agreement wholly without charge to the said ———, but if the plantation described in paragraph 1 be of such a nature as to require inspections subsequent to the preliminary examination, and such inspections be made upon the special request of the owner, said owner shall pay the actual and necessary expenses for traveling and subsistence of the agent or agents of the Department working under this agreement. What are "actual and necessary expenses" shall be determined by the printed regulations of the Department.

6. The Department of Agriculture shall have the right to publish and distribute the said plan and its results for the information of farmers and others whom it may concern.

7. This agreement may be dissolved by either party upon ten days' notice given to the other.

(Signed) ———,
 Owner.

(Signed) ———,
 Secretary of Agriculture.

Post-office: ———, Date: ———

The working plan above mentioned, being completed, is now accepted, and will be carried out under the conditions and during the validity of the above agreement.

(Signed) ———,
 Owner.

It is necessary that persons who desire the assistance of the Division, as indicated in this agreement, should make their applications some months in advance of the time when they desire to plant, in order to afford ample opportunity for an agent of the Division to visit the land of each applicant and complete the plans under which the work is to proceed sufficiently early so that the necessary young trees and seeds may be obtained from the most desirable regions and from responsible seed dealers and nurserymen in time for spring planting.

THE COOPERATIVE PLAN.

The method by which the Division carries on the cooperative work in tree planting is as follows:

Every application when received is placed on file, and the applicant notified of its receipt. As soon as it is ascertained at what time an expert tree planter of the Division will be able to reach the land owned by the applicant, he is notified when the agent may be expected, and later, the day and hour when he will arrive. In places where suitable arrangements can be made a public meeting is arranged for, so that all persons in the neighborhood interested in tree planting may attend it and confer with the agent on any matter pertaining to forest tree planting.

The agent, accompanied by the applicant, goes over the ground of each of the proposed plantations, and obtains all available data that will be of assistance to him in making planting plans best suited for each farm visited. On account of the effect of local conditions on tree growth this personal examination is necessary in order to give trust-

worthy advice regarding the method of planting and the kinds of trees to plant.

The following are some of the local conditions which must be taken into consideration in satisfactorily establishing plantations of forest trees:

- (1) In prairie regions trees that succeed on bottom land and bench land frequently fail on upland.
- (2) The position of the farm buildings and orchards must be known in order to plant shelter-belts and wind-breaks most advantageously.
- (3) The local soil and moisture conditions determine in a large measure the best trees to plant and the best place for the plantation.
- (4) The purpose of the plantation must in a degree determine the kinds of trees to plant.

From the data obtained by personal examination and consultation with the applicant, planting plans are made and sent to the owner. These plans include a carefully prepared map of the whole or a part of the farm visited, having the proposed wind-breaks, wood lots, shelter-belts, or other forest plantations platted upon it. The instructions incorporated in the planting plans state specifically the way to plant and the number of each species required to complete the plantation, and when mixed plantations are recommended diagrams show how these mixtures are to be made. Sundry instructions are also included regarding the growing of forest-tree seedlings, care of nursery stock, special care of evergreens, and the preparation of the soil.

At the time the examination is made by the agent the applicant signs the agreement at the first point indicated, thus expressing his desire to have planting plans prepared, under the conditions stated therein. After the planting plans are prepared and the agreement signed by the Secretary of Agriculture, they are transmitted to the owner, and, if accepted by him, he signs the agreement inclosed with the plans, at the second point indicated, and returns it to the Division of Forestry. In instances where it is considered necessary, and when circumstances permit, visits are made to the cooperative plantations after the planting plans have been put into execution, and, in some cases, during the time of planting, but such visits are made at the expense of the Division of Forestry, unless specifically requested by the applicant.

Although this plan of cooperation has been in operation less than a year, the results already obtained in bringing the Division into closer relations with land owners desiring to establish plantations of forest trees, particularly in the treeless regions of the West, are most satisfactory, and the work is rapidly expanding.

THE TREE-PLANTING SECTIONS OF THE UNITED STATES.

Although applications for assistance in establishing plantations of forest trees are being received from nearly every State, more than 90 per cent come from the treeless regions of Texas, Oklahoma, Kansas,

Nebraska, and the Dakotas, regions where tree planting is most needed for protection to stock, orchards, and buildings, and for fuel, posts, and other farm purposes.

This center of tree-planting activity, being as it is an open prairie, must depend upon careful and painstaking planting to approach the conditions prevailing in regions originally wooded, where trees grow when once planted without further attention. This fact is most forcibly illustrated in the present condition of many tree claims on the prairies of the West. Although occasional plantations have been successful, as illustrated in Plate I, fig. 1, the greater number, on account of unfavorable locations or lack of proper attention in planting and subsequent care, have been failures. The illustration shown in Plate I, fig. 2, represents the present condition of hundreds of such claims, and is a strong argument in favor of better judgment regarding the selection of locations for plantations and of fuller knowledge of the proper care and management of forest trees in the plantation.

Adjacent to the great plains between the Rocky Mountains and the Mississippi River there is both an eastern and a western limit of tree growth under natural conditions—that is, a place where trees give way to lower forms of vegetation. This limit is largely fixed by the amount and the season of rainfall, although before the period of settlement it was determined to considerable extent by prairie fires. If we plant trees beyond this limit it is evident that they will have to be handled differently from the way nature treats the trees which spring from seeds blown or otherwise carried upon prairie lands from distant woodlands. In the latter case the self-sown seeds frequently germinate, but in the struggle of the young trees for existence among the prairie grasses they invariably die. If they did not there would be no prairies. Therefore, when young trees are planted beyond the limits of natural tree growth they must be given some advantage over the indigenous vegetation or they will die, for the same reason that trees starting from self-sown seeds die. They must be protected.

There is probably not a single inhabited region in the United States where some kinds of trees may not be made to grow when given adequate assistance in the way of cultivation and irrigation. In regions of extremely adverse conditions only the hardiest varieties exist, and then only as stunted, poorly developed specimens, even when the best effort is made to modify the existing conditions. On the other hand, in prairie regions adjacent to natural woodlands many varieties of trees grow almost as well, when once established, as they do in the natural forest. The treeless West presents every intermediate condition between these two extremes, but in every case some adverse conditions, calling for more or less effort on the part of man, must be overcome. If these conditions are overcome, trees will grow; if they are not, they will die.

The chief object of the cooperative tree-planting work of the Division



FIG. 1.—A TIMBER CLAIM IN THOMAS COUNTY, KANS., 10 YEARS OLD, AND IN GOOD CONDITION.
The shade is now sufficiently dense to produce a fair forest floor and prevent the growth of prairie grasses.



FIG. 2.—A TIMBER CLAIM IN HOLT COUNTY, NEBR., WHERE FOREST CONDITIONS WERE NOT ATTAINED.
The prairie grasses were allowed to occupy the land and the trees gradually died out.

of Forestry is to assist tree planters in overcoming these adverse conditions, and to aid in the establishment of plantations of the greatest possible value to their owners.

FAVORABLE LOCALITIES FOR TREE PLANTING.

Nearly everywhere within the natural wooded areas trees grow with little or no care. Although these localities are especially favorable for tree growth, favorable situations of limited area are not infrequent in what are generally known as treeless localities. In many Western situations where only the hardiest trees succeed at all upon upland and exposed places, benchlands and lowlands along creeks and rivers where the valleys are naturally subirrigated are usually well adapted to tree growth. Such conditions are frequent in the valleys of the Platte, Arkansas, Cimarron, and other rivers of the plains.

In many localities west of the ninety-ninth meridian, and even farther east, much depends upon the selection of the site for the plantation of forest trees upon each individual farm. The question of the location of the farm buildings in relation to future plantations is also of critical importance.

A PLANTATION FOR GENERAL PURPOSES IN SOUTHERN KANSAS.

The following account of the plantation of Joseph Lewis is presented as an evidence of what can be done on the open prairie in a short space of time. This plantation is located in the southern part of Harper County, Kans., in the valley of a small stream called Silver Creek. The soil is a fertile, brown, sandy loam, and reaches some 6 or 8 feet in depth. It is freely permeable, both to water and the roots of trees, containing much water when saturated, and has marked retentive powers. The subsoil is similar to the soil, and a uniform layer of coarse, water-bearing sand is found at a depth of about 15 feet. This kind of soil is producing better trees than any other in the unforested West.

Mr. Lewis settled on this land a little over twenty years ago. He immediately began to improve it, but his main forest plantations were not made until 1882. At this time a 30-acre plat was laid out for an orchard, and on the north, west, and south of this plat a windbreak was planted. On the north of the orchard a strip some 20 rods in width was planted with Cottonwood. On the west a strip about 15 rods wide was planted, at one end with Soft Maple, and at the other with Black Walnut, with the trees about 6 feet apart in one direction and 8 feet in the other. On the south a strip varying in width from 10 to 15 rods was irregularly and thinly planted with Cottonwood, Red Cedar, Soft Maple, Russian Mulberry, and Catalpa. The site of this plantation slopes gradually southward to the creek, which is the

boundary of the planting on the south side. On the north side of the plantation the land is from 5 to 10 feet higher than the south side, but of the same kind of soil.

The Cottonwoods made the most rapid growth. Twelve years after planting they were 40 feet or more in height, with trunk diameters breast high of 10 to 12 inches. Two or three years ago nearly all of these trees were cut down. The Cottonwoods on the south side of the plantation, however, were allowed to remain. The house stands among them, and the yard and lots receive ample shade and protection from their broad spreading tops. They are now 50 and 60 feet tall, with tops reaching a maximum diameter of 40 feet.

The Russian Mulberry has made a most vigorous growth. The trees were allowed to branch low, but have reached the height of 30 feet, and have dense tops. Their diameters range from 12 to 14 inches. The branches of these trees would now form ten or twelve good posts to each tree. Soft Maples planted at the same time are now large thrifty trees, 40 feet high and 8 to 10 inches in diameter. They have not yet yielded to the tendency to die out in the top and become stag-headed, so frequently noticed of this species in many places in the West, especially over a clay subsoil. Plate II, fig. 1, represents the present condition of the Soft Maple plantation on this farm, and is in marked contrast to a similar plantation illustrated in Plate II, fig. 2, where desirable forest conditions were not attained.

The Black Walnut is growing near the Maple, so that the difference in size is readily recognized. The diameters are about half as great in the Walnuts as in the Maples. They are now from 4 to 6 inches in diameter, and are from 25 to 35 feet high. With proper care in thinning, the Walnut plantation will stand for many years as a monument to the man who planted and reared it.

One of the most thrifty and profitable orchards in the State of Kansas has been grown in the shelter and protection of this grove. In his report to the Kansas Horticultural Society Mr. Lewis, speaking of his orchard, says, "I believe windbreaks are essential in this country."

The planting on this farm has been of the most practical sort. For the most part desirable trees have been used. They have been planted advantageously both in relation to favorable soil and to the benefits which may be derived from their growth. They were well cared for until they were large enough to protect themselves. The results of this plantation are: First, fuel for household use; second, posts and poles for the building of fences, sheds, and cribs; third, protection to feed lots and buildings from wind and sun; fourth, a profitable commercial orchard in a region where unprotected orchards are a failure; fifth, an increased value of the entire quarter section of land of at least \$10 per acre.

What has been done on this farm can not be done upon every farm in the West, because the soil and moisture conditions are more favor-



FIG. 1.—SOFT MAPLE FOREST PLANTATION, 17 YEARS OLD, IN HARPER COUNTY, KANS.
Trees 8 to 12 inches in diameter and 35 to 46 feet high. In excellent condition.



FIG. 2.—SOFT MAPLE FOREST PLANTATION, 12 YEARS OLD, IN PALO ALTO COUNTY, IOWA.
Trees too far apart to keep out the grass. In poor condition.

.

—





FIG. 1.—SITE FOR FOREST PLANTATION, ACCORDING TO PLANTING PLAN No. 5, IN EDDY COUNTY, N. DAK.



FIG. 2.—BLACK LOCUST FOREST PLANTATION, 12 YEARS OLD, IN MEADE COUNTY, KANS.

Trees 6 to 8 inches in diameter and 30 feet high.

able here than in many places; but there are, nevertheless, millions of acres upon which this successful tree growth can be duplicated.

Successful as this plantation has been, it lacks the element of permanence. Already part of the Cottonwood grove has been cut away, and the land is again prairie. Not an acre of Western prairie land that has been transformed into forest should ever be allowed to revert. The Cottonwood and Boxelder should yield only to the Locust, Ash, Walnut, and Oak, for valuable timber should be the ultimate aim of every Western planter.

Plate III, fig. 1, illustrates what may be expected on the plains of the West in a pure plantation of Black Locust, on soil best adapted to its growth, when properly planted and cared for. In contrast with this desirable plantation, which may be attained with this or other species in many Western regions, there is presented in Plate III, fig. 2, an illustration of the site for a proposed plantation in North Dakota on the open, wind-swept prairie.

PLANTING PLAN FOR A PLANTATION FOR GENERAL PURPOSES ON
THE FARM OF MR. P. G. JACOBSON, MADISON, MINN.

This farm is located one-half mile north of Madison, the county seat of Lac qui Parle County, Minn., on the east $\frac{1}{2}$ of section 17, township 118, range 44, west of the fifth principal meridian.

The region in which the farm is located consists of high rolling prairie, with neither natural forest nor natural elevations to break the force of the wind which sweeps over the country at all seasons of the year. The farm consists of 320 acres, at an elevation of about 1,200 feet above the sea level. The surface has no uniform slope, but, owing to a number of knolls with low and irregular depressions between them, slopes in all directions are to be found. These are gradual and slight, with the difference in elevation between the knolls and depressions of not more than 8 to 10 feet. No creeks, ravines, or water runways occur upon the farm.

The soil, like that of the entire region, is a deep, black, heavy marl of glacial origin, with enough clay to make it adhesive when wet, and somewhat difficult to cultivate. It contains a large admixture of vegetable mold, which renders it more porous and friable than it would otherwise be. Its absorptive capacity is large and its retentive powers so great that it resists drought very well.

At a depth of from 3 to 4 feet a light, yellow clay subsoil appears and continues down to the water level, some 20 to 25 feet below the surface. It is sufficiently porous to allow the percolation of water through it, and at times becomes so saturated that the water drains out into cellars.

The several farm buildings are located near the south side of the farm, adjacent to the public road, which follows the section line. In

front of the house, near the road, is a low, swamp-like spot one-half acre in extent, which will be drained. A residence is to be erected in the future somewhat in front of and a little to the east of the present house.

The plantation for general purposes proposed for this farm is as follows: Beginning on the south line of the farm, a wind-break 15 rods wide, will extend northward 60 rods; at the north end of this and forming an L with it, a belt 6 rods wide, extends 30 rods to the east.

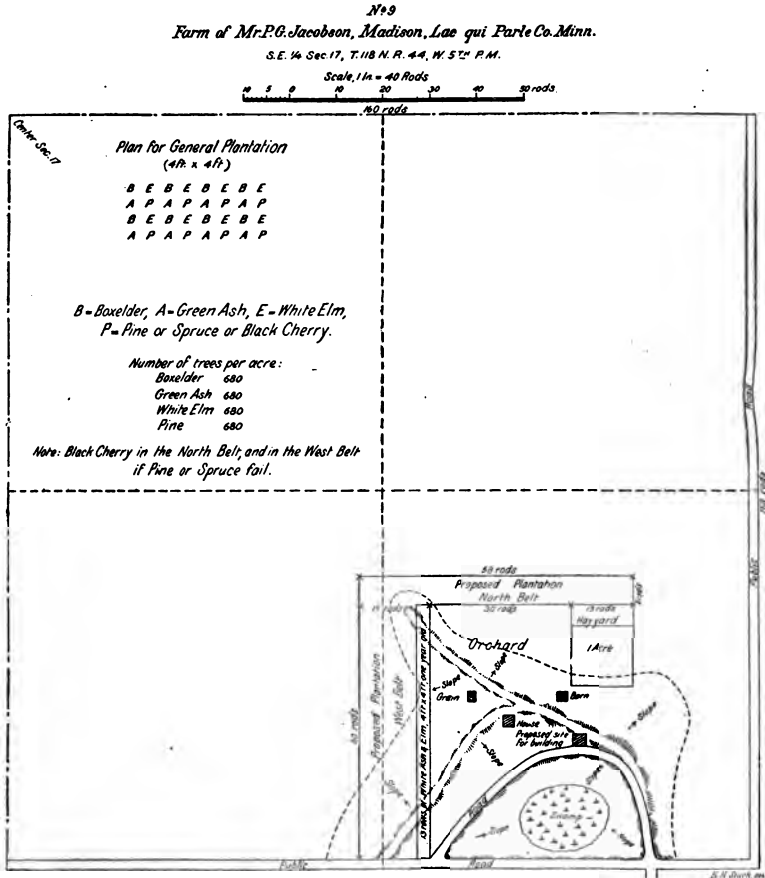


FIG. 1. Planting plan No. 9, for a plantation for general purposes on the farm of Mr. P. G. Jacobson, Madison, Minn.

This plantation will protect the buildings and lots on the west and north and also an orchard which will be planted on the slope north of the house. The present plantation will cover 8 acres. Later it will be extended west and north until 15 acres are covered. The north part of the plantation is on a northern slope, the south part on a southern slope. The land has already been plowed in preparation for spring planting.

The purposes of the plantation are general: First, to serve as a wind-break, shielding the house, barn, and orchard from the southwest, west, northwest, and north winds; second, to provide a supply of fuel, posts, and poles for farm use; third, to increase the value and attractiveness of the farm. With these objects in view it is desired to plant such trees as will thrive and produce a grove of timber of good appearance and quality. It is so planned that if properly managed it should grow more valuable with age and endure as a permanent plantation.

The only planting already done upon the farm consists of 1,000 each of White Ash and Elm, set last year 4 by 4 feet apart on the site of the west belt. Nearly all the trees grew. The owner desires to make this a part of the permanent plantation.

In neighboring plantations White Elm, White Ash, Boxelder, White Willow, Cottonwood, Russian Poplar, and Balm of Gilead have been grown with success. Soft Maple thrives, but is badly broken by the wind in winter when covered by ice and snow. White Pine, Austrian Pine, Scotch Pine, and White Spruce in limited quantities have been tried, but have suffered from winterkilling. As the summer growth is very rapid and does not usually mature fully, the trees are easily killed by the ensuing cold of the winter. It is the general opinion that conifers will not be successful in this community, but the conclusion is based on too limited experience. The following plan will be followed in the execution of this planting:

Plan for general plantation.

(4 feet by 4 feet.)

B	E	B	E	B	E	B	E
A	P	A	P	A	P	A	P
B	E	B	E	B	E	B	E
A	P	A	P	A	P	A	P
B	E	B	E	B	E	B	E
A	P	A	P	A	P	A	P
B	E	B	E	B	E	B	E
A	P	A	P	A	P	A	P

B=Boxelder. A=Green Ash. E=White Elm. P=Pine, Spruce, and Black Cherry.

Number of trees per acre.

Boxelder.....	680
Green Ash	680
White Elm.....	680
Pine, Spruce, and Black Cherry	680

NOTE.—Black cherry should be planted in the north belt as alternate trees in the even rows; this will take about 1,500 trees. The 3,850 coniferous trees should occupy similar positions in the west belt.

EXPLANATION OF PLAN.

The planting is to be made in two belts, one on the north of the buildings, 6 by 30 rods, and one on the west of the buildings, 15 by 60 rods.

The plan calls for Boxelder, Green Ash, White Elm, Black Cherry, and conifers. In the first row Boxelder and Green Ash are to alternate, in the second row White Elm and a conifer alternate in the west belt, while in the north belt Black Cherry comes in the place of the conifer. The conifers, which consist of 1,100 White Pine, 1,250 Red Pine, and 1,500 Douglas Spruce (Red Fir), are not to be set in the permanent plantation during the spring of 1900, but are to be set 1 foot apart in nursery rows. If their growth be rapid, cultivation should cease by midsummer. Next winter they may be slightly protected by straw placed about them. In the spring of 1901 they are to be set in the permanent plantation. It is recommended that 1-year old seedling deciduous trees be used in the planting, on account of their cheapness and the ease and safety of transplanting.

To insure hardiness in the stock the trees are to be obtained from nurseries with climate corresponding to that into which they are to be transplanted.

The method of mixing the trees is definitely shown by the accompanying planting plan.

In case the Black Cherry can not be obtained for planting this spring its planting may be delayed till the spring of 1901. An order for the stock should at once be placed with a nurseryman, so that he may be able to have it when needed.

CARE OF NURSERY STOCK.

When forest-tree seedlings are received from the nursery, they should be immediately unpacked, the roots puddled, and the plants heeled in to await favorable weather for planting. Yearling stock, which is the best age for such quick-growing varieties as Cottonwood, Boxelder, Soft Maple, Russian Mulberry, Catalpa, White Elm, Black Cherry, Black Walnut, Black Locust, and Honey Locust, will seldom require special treatment. If they have made unusual root growth it may be necessary to prune the roots in order to make the planting easier, but this should be sparingly done. It is quickly accomplished by chopping the tips with a sharp ax before the bundles are untied, leaving the roots at least 8 inches long.

Before the plants are unpacked a puddle should be made by digging a hole convenient to the place of heeling in, and mixing in it equal parts of loam and fresh cow dung with enough water to reduce the whole to a mixture sufficiently thick to adhere to the roots readily. As each bundle is taken out it is untied, the roots spread, and dipped in the puddle to the collar, so that every root is covered. A trench having

been previously opened a spade deep, with one side an inclined plane, the puddled trees are spread upon the slant in a thin layer, care being taken to have the collars as nearly uniform as may be, and the trees are then covered with a thin layer of fine soil, which should reach an inch or two above the collars. This is firmly tramped, and well smoothed, and then a second layer of trees is "heeled in." The soil adheres to the muck on the roots, and thus prepared they can be handled with much less danger of drying than if heeled in without puddling.

Each species should be heeled in by itself, one layer against another, with a narrow alley between it and the next species. If the trees are to remain heeled in for some little time a shady location should be selected, or the trees should be shaded with a light mulch of straw or prairie hay.

The trees should be left thus heeled in until favorable weather for planting comes. It is the variable weather of early spring which is so often responsible for failure in tree planting, and in the West particularly every precaution should be taken to use the most favorable time for planting. To this end stock should always be ordered to be delivered at the earliest possible date after danger of freezing in shipment is passed. If received when the ground is frozen it may be kept safely in a cool cellar, to be heeled in when the frost is out of the ground. If the spring rains are delayed, the stock should not be disturbed. This is why it is important to heel in trees on the north side of a barn, or other place where the shade will retard their sprouting.

If the soil is in good condition as to moisture, cloudy weather is the most favorable for planting, not only because there is less danger of drying the roots of the trees, but also because there is less evaporation. A few days of cloudy weather will enable the trees to establish themselves almost without check.

Conifers, with the exception of Larch, should be left to the last in planting, as they start later than broadleaf trees. It frequently happens that large loss of Pines, Cedars, and Spruces is caused by early planting, followed by a period of bright sunshine and dry weather. Had the conifers been left in the shade well-heeled in they would have been protected from the bright sun, and in good condition for planting when the rains came.

Many successful planters never set evergreens until the root tips show signs of growth. If when the root tips begin to swell and whiten the soil moisture is favorable and cloudy weather prevails, the best possible combination of circumstances for transplanting has been secured.

TRANSPLANTING EVERGREENS.

Evergreens require more careful attention in transplanting than deciduous trees. The latter may dry out and become shriveled, yet with proper attention be revived and live, but the former, once dried in the least, never regain their vitality. This accounts for many fail-

ures in transplanting evergreens. The rules laid down for the handling of deciduous trees when received from the nursery need not be changed for conifers, but they must be followed with very much more care and exactness. It is necessary that no delay shall occur during shipment and that the stock should be taken care of immediately upon reaching its destination. The planter must not let anything whatever interfere with the immediate unpacking, puddling, and heeling in of the stock. Heel in the trees in a cool place protected from sun and wind, and await a favorable day for planting. The stock should be on hand by the time the ground ceases to freeze, and should be planted in the first good planting weather thereafter. It is unwise to delay, for another favorable time may not come. Good planting weather should be construed to mean a time when the soil is well supplied with moisture, and a day when the sun is obscured by clouds and the atmosphere moist and still. Setting the trees is the final act in a very important series of movements. Perform it as though everything in the success of the trees were dependent upon it. See that the roots are kept moist all the time, that the holes are ample for them, and that good soil is firmly packed about them. Usually the best success is attained by planting evergreens very close together, growing them, particularly in prairie regions, under partial shade for one year after they are received from the nursery, and placing them in the permanent location the following spring. It is sometimes necessary to clip the side branches of evergreens that the tops may be reduced in proportion to the roots. Never allow the leader to be injured in any way.

PREPARATION OF THE GROUND.

Trees succeed best upon land which has been thoroughly subdued from the wild condition. Four or five years of cultivation should usually precede the planting of trees on most prairie soils. After the first breaking of the sod, which is properly very shallow, the plowings should be successively deepened until 7 or 8 inches of the surface soil have been mellowed by cultivation and weathering. The growing of farm crops, especially deep-rooting crops such as corn, helps much to prepare the ground for the reception of trees. In the fall previous to planting, the land should be plowed deeply and left rough over winter. In the spring it should be worked into a mellow condition and marked for planting. An implement such as a corn marker may be used, but in many portions of the West a furrow made with a plow or lister is to be recommended. The rows should be carefully spaced by measurement rather than by guess. If the rows are correctly spaced and staked it is usually a very easy matter to run them very nearly straight. If the soil tends to dry out rapidly the furrows should not be made far ahead of the planting.

In almost all cases it is necessary to space the trees by measurement in the rows. This may be easily done by means of a check

row line, marked so as to show where the trees are to stand. If care be taken to establish the line correctly in each row and to plant by the mark, the cross alignment will be very accurate.

The trees should be set a little deeper than they grew in the nursery and should have the fine surface soil made firm about the roots. They should have thorough surface cultivation, especially during the early part of the season. In most sections of the West cultivation should continue all summer, but in the North, where the seedlings are likely to winterkill if the wood is not well matured, cultivation should cease in late summer.

Cultivation carried on in this way should be the unfailing rule in almost all Western planting. It must be continued until the shade of the trees becomes so dense that weeds will not grow and the leaves, gathering on the ground, form a mulch between the trees sufficient to retain the moisture in the soil.

On account of more rapid growth in plantations made along streams, frequent cultivation can not, in all instances, be followed. In such cases the natural moisture of the soil and the adaptability of the location to tree growth may be sufficient to equalize the loss which the tree sustains from lack of tilth.

A PLANTATION FOR SPECIAL PURPOSES IN CENTRAL KANSAS.

The Catalpa plantation of Mr. L. W. Yaggy, located 4 miles west of Hutchinson, Kans., in the sandy valley of the Arkansas River, is a most interesting example of the growing of forest trees as a financial investment. The plantation consists of 440 acres planted entirely to Hardy Catalpa at the uniform distance of $3\frac{1}{2}$ by 6 feet apart. The first planting, consisting of 120 acres, was done in 1890; 80 acres were planted in 1891, and 240 acres in 1892. On account of the expense and difficulty of obtaining trees from commercial nurseries for the planting of so large a tract, Mr. Yaggy grew his own stock, thereby greatly reducing its cost. The trees were set in the permanent plantation when 1 year old. They were planted in furrows laid off 6 feet apart. A line was stretched in the furrows, marked at spaces of $3\frac{1}{2}$ feet, and stationed each time so that the rows should begin evenly. The trees were set at the points marked on the line, and a fair alignment was secured in all directions.

Almost a perfect stand was obtained, and, except in a very few spots of hardpan, the trees made a rapid growth from the first. The soil upon which the plantation is located is a sandy loam several feet in thickness, underlaid by a soft clay subsoil, which also contains a large admixture of sand. Both soil and subsoil are permeable to water and are well adapted to tree growth. The water table is about 8 or 10 feet below the surface. The subsoil and soil are thus subirrigated, so that the trees do not suffer from lack of moisture.

When the trees were 2 years old they had formed tops by branching

at 3 to 5 feet from the ground. As the object of the owner was to secure straight, clear boles, the branching was considered a defect. The trees were therefore cut back to the ground, leaving, however, several strips of 3 rows each at uniform distances apart, extending east and west through the plantation as windbreaks for the tender growth of the next season. The stump of each tree so cut back threw out several sprouts which reached a height of from 6 to 12 feet the following season. The next winter most of the sprouts were cut away, leaving only the most vigorous one at each stump to form the tree. During the following year the upward growth continued, side branches appearing at heights varying from 8 to 12 feet. According to Mr. Yaggy's statement, given below, cultivation ceased after the third year. After this the shade of the trees became so dense that weeds and grass did not grow. The accumulation of leaves soon formed a mulch, so that the transition from a cultivated field to a dense young forest with excellent conditions of forest floor and cover was complete.

Thinning began in the older parts of the plantation in the winter of 1897-'98. After six seasons' growth from the time of cutting back, 2,500 trees were cut from an 80-acre tract, and the next year 13,000 trees were removed from the same tract. In each cutting only the largest trees were taken. Each tree removed made 2 posts, the larger with a butt diameter of from 4 to 6 inches, and the smaller of from 2½ to 3½ inches. The posts were sold at the plantation, the lower cuts bringing 10 cents each and the upper ones from 4 to 6 cents each. About one-eighth of the trees were removed in these two cuttings. An illustration of the present appearance of this plantation is shown in Plate IV, fig. 1.

Through the courtesy of Mr. Yaggy, valuation measurements of two typical areas of one-half acre each, one on the exterior and one on the interior of the plantation, were made in January, 1900, under the direction of the Division of Forestry. The measurements were made by the foreman of the farm, working under the following instructions:

Mark off one-half acre on the north edge of the older plantation, representing an average of the outer area of the plantation. This area should extend 10 rods south, including 27 rows of trees, and 8 rods west. The trees on this area are to be counted and their diameters measured with calipers, at heights of 1 and 7 feet. When measuring the trees a record is to be made of the number of posts and stakes each would furnish at the present time, and the value of each reckoned on previous sales from the plantation. A record is also to be made of the value of the wood contained in the parts of the tree unfit for posts and stakes. The measurements and records for each tree are to be tabulated upon sheets forwarded from the Division of Forestry. These sheets are ruled into columns headed to show the number of the tree, the diameter 1 foot above ground, the diameter 7 feet above ground, number of posts the tree will make, value of posts, number of stakes, value of stakes, value of wood, and total value of tree. As few stumps as possible are to be included in the areas mentioned, but where trees have been cut the diameters of the stumps are to be taken and an estimate made of the value of the posts and stakes obtained from them.

The same measurements are to be taken on a half acre similarly laid off, represent-



FIG. 1.—THE YAGGY CATALPA PLANTATION, IN RENO COUNTY, KANS.

Rows 7 to 12 feet apart; age 10 years. Trees 4 to 6 inches in diameter and 25 to 28 feet high.



FIG. 2.—THE YAGGY CATALPA PLANTATION, IN RENO COUNTY, KANS., SHOWING POSTS CUT WHEN TREES WERE 9 YEARS OLD.

The posts are from 4 to 6 inches in diameter, and many of the trees made two posts.

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ing the interior conditions of the grove, and located far enough within the plantation to be entirely uninfluenced by the open ground.

The results of the measurements are shown in the following table:

Locality.	Area.	Number of trees.	Number of posts.	Value.	Number of stakes.	Value.	Value of wood.	Total value of trees.
Edge of plantation.....	<i>Acres.</i> $\frac{1}{2}$	944	811	\$81.10	1,888	\$47.87	\$28.92	\$157.89
Interior of plantation.....	$\frac{1}{2}$	891	496	49.62	1,341	36.15	23.49	109.26
Total on average acre.....	1	1,835	1,307	130.72	3,229	84.02	52.41	267.15

From these figures it appears that the gross value of the timber crop produced in ten years is \$267.15 per acre.

In reckoning the cost of the plantation per acre, Mr. Yaggy's own figures have been used. They are as follows:

I bought the best river-bottom land, with rich, moist, loamy soil, for which I paid \$25 per acre. It was cultivated in corn two years before I planted trees upon it. The cost of raising sufficient trees to plant an acre was \$3.60; cost of planting with listers and plows, \$3.20 per acre. The rows being 6 feet apart, rows of corn were planted between the rows of trees. In cultivating the corn the trees received nearly as much cultivation as was necessary. About three cultivations were sufficient the first year, cost \$1.20. The second year the trees needed no cultivation. The third year three cultivations were sufficient. After that time no more care was required.

It costs about \$2.50 per acre to cut back the trees and sprouts. If the cutting off is done early, the cost is small; if it is done when the trees are 3 or 4 years old, the wood pays for the cutting. One sprouting in July (the year following cutting back) is sufficient:

The foreman of the farm states that it costs $1\frac{1}{2}$ cents each to cut and deliver posts at the station; from which statement we estimate that the cost of marketing the present crop is \$20 per acre.

Counting the rent of this land at \$2 per acre, the expenses of growing the crop and marketing the product at the present time are therefore to be summarized for 1 acre as follows:

Rent of land 10 years, at \$2	\$20.00
Cost of raising plants from seed.....	3.60
Cost of planting.....	3.20
Cost of cultivation, first year	1.20
Cutting back and sprouting.....	2.50
Cost of cultivation, third year	1.20
Cost of marketing crop	20.00
Total	51.70

Deducting \$51.70, the total cost of growing and marketing the timber grown on 1 acre, from \$267.15, which is the gross value of the product in hand, there remains a net value of \$215.45 per acre, or, including the interest on the investment, an annual profit of \$21.54. Allowing 6 per cent compound interest on the expenditures from the time

incurred until the expiration of the ten years, the total expense per acre was as follows:

Year.	Amount ex- pended.	Amount 6 per cent compound interest.
First.....	\$10.00	\$17.91
Second.....	4.50	7.60
Third.....	3.20	5.10
Fourth.....	2.00	3.00
Fifth.....	2.00	2.84
Sixth.....	2.00	2.62
Seventh.....	2.00	2.52
Eighth.....	2.00	2.38
Ninth.....	2.00	2.25
Tenth.....	22.00	23.32
Total.....	51.70	69.60

Deducting \$69.60 from \$267.17, the gross value, we have a net profit of \$197.55 per acre.

These results show the value of an acre at the present time when the trees are but 10 years old. It would be very unwise to remove all the trees at this time. If only a portion of the trees are marketed each year for the next 10 years, and the trees cut out are distributed so as to give more sunlight to those that remain, the net profit per acre will be very much increased.

Plate IV, fig. 2, is an illustration from the edge of the plantation where the posts have been drawn out and are made ready for market.

The results obtained by Mr. Yaggy can not be duplicated by every farmer in the Catalpa belt. The loose, sandy soil of this plantation, with water table from 8 to 10 feet below the surface, is particularly adapted to the growth of the Catalpa.

A notable instance of a Catalpa plantation unwisely located is found near Kiowa, in Barber County, Kans. This plantation for the most part is on dry upland. The soil is composed of red loam underlaid with sandstone at a depth of 8 to 12 feet. In 1883, 250,000 nursery grown trees were set in the plantation. A large proportion of the trees used were Hardy Catalpa, but some Black Locust, Black Walnut, Russian Mulberry, and Black Cherry were also planted in mixture with the Catalpa. Large areas of this plantation have entirely died out, although the cultivation for several years was the very best.

It is noticeable that the trees on the higher lands have suffered most, and those that survive are only a third or a half the size of those in the ravines. Although these trees were set seventeen years ago, the largest of the Catalpas will make but one good post, while those that remain in the drier portions of the plantation have branched near the ground and are of no value except for fuel. The location is unsuited for the growth of the Catalpa. The Locust, Mulberry, and Elm do much better, but even these can not be called wholly successful.

PLANTING PLAN FOR A PLANTATION FOR SPECIAL PURPOSES ON THE FARM OF MR. JESSE H. DUNN, ALVA, OKLA.

The farm is located one-half mile east of the town of Alva, the county seat of Woods County, Okla., on the S. $\frac{1}{2}$ NE. $\frac{1}{4}$ of sec. 24, T. 27, north of base line, range 14, west of Indian meridian.

This farm, consisting of 80 acres, adjoins the town site of Alva on the east. It is near the south side of the Salt Fork of the Arkansas River,

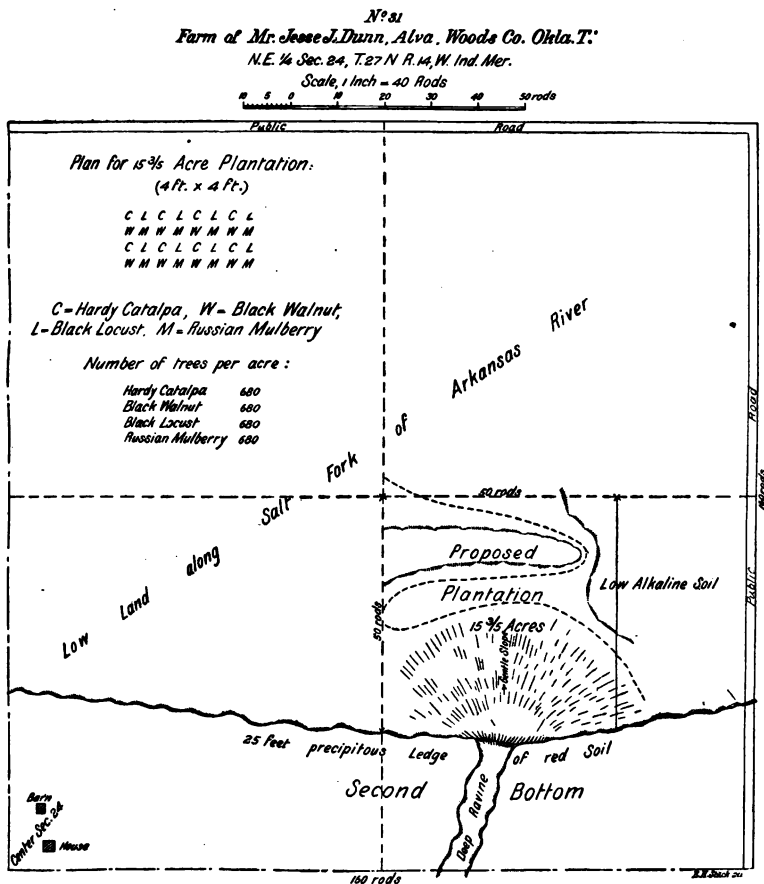


FIG. 2. Planting plan No. 31, for a plantation for special purposes on the farm of Mr. Jesse J. Dunn, Alva, Okla.

and comprises about 50 acres in the low bottom of the river, and 30 acres on the second bottom lying 20 to 25 feet higher. The embankment separating the first bottom from the second is an almost perpendicular bluff of red marl about one-half mile from the river. The first bottom is low and for the most part is level land from 4 to 8 feet above

the level of the river. In composition the soil varies from loamy sand to clay, being a mixture of the sand of the river and the red clay of the uplands. Water-bearing sand occurs at a depth of from 2 to 6 feet below the surface. In some of the lower places alkali appears in such quantity as to interfere with the growth of the blue-stem grass that for the most part covers the bottom. On account of the nearness of the underground water to the surface, and the fact that the river sometimes overflows the lower portion, the land is frequently wet.

A wide difference exists between the conditions in the first and second bottoms. The latter, depending entirely upon rainfall, has a very dry though fertile soil. In composition it is a deep, heavy, red marl. A large ravine or canyon opens into the river valley at the point where the plantation is to be made.

The red soil and the subsoil of the first bottom is readily penetrated by water, and when saturated holds much moisture. Owing to the very finely divided condition of the soil particles, the capillary movement of moisture through the soil is quite rapid, so that the retentive power is not naturally great. In the low valley this strong capillarity is advantageous, because it tends to keep the surface soil constantly supplied with moisture from the undiminishable supply below.

The proposed plantation is a tract 50 rods square, lying wholly in the first bottom, near the east side of the farm. It is bounded on the south by a high bluff, and contains the mouth of the ravine mentioned above, with its alluvial deposit. The land was first broken four or five years ago, but the sod has never been killed and each spring renews its growth. If the land remains uncultivated for a season the sod becomes almost completely reset. Considerable growth of Willow and False Indigo occurs in places.

There is but little natural tree growth in the river valley and none on the upland. Cottonwoods 50 to 60 feet high grow on sand bars in the valley, where fire cannot reach them, and others have grown in protected places under the bluff. It is probable that frequent fires account for the present nonforested condition of the river bottom. In the canyons extending back from the river, White Elm, Honey Locust, Hackberry, and Soapberry occur as scattering trees. Formerly Red Cedar occurred in places, but this has nearly all been cut down. Owing to the fact that this region has been settled but six years, no plantations of more than five years' growth are to be found. Those which have been made are mostly small and consist of Cottonwood. The growth of the trees in these groves has been very rapid, averaging 3 or 4 feet per year. All of these plantations have been made upon the upland, and they have not yet reached the age when the Cottonwood begins to fail in such locations.

The special purpose of this plantation is the production of timber suitable for posts. It must contain a mixture of species which will

give durability to the plantation. The following plan of planting is proposed in the execution of the planting plan:

Plan for special plantation.
(4 feet by 4 feet.)

C	L	C	L	C	L	C	L
W	M	W	M	W	M	W	M
C	L	C	L	C	L	C	L
W	M	W	M	W	M	W	M
C	L	C	L	C	L	C	L
W	M	W	M	W	M	W	M
C	L	C	L	C	L	C	L
W	M	W	M	W	M	W	M

C=Hardy Catalpa. W=Black Walnut. L=Black Locust. M=Russian Mulberry.

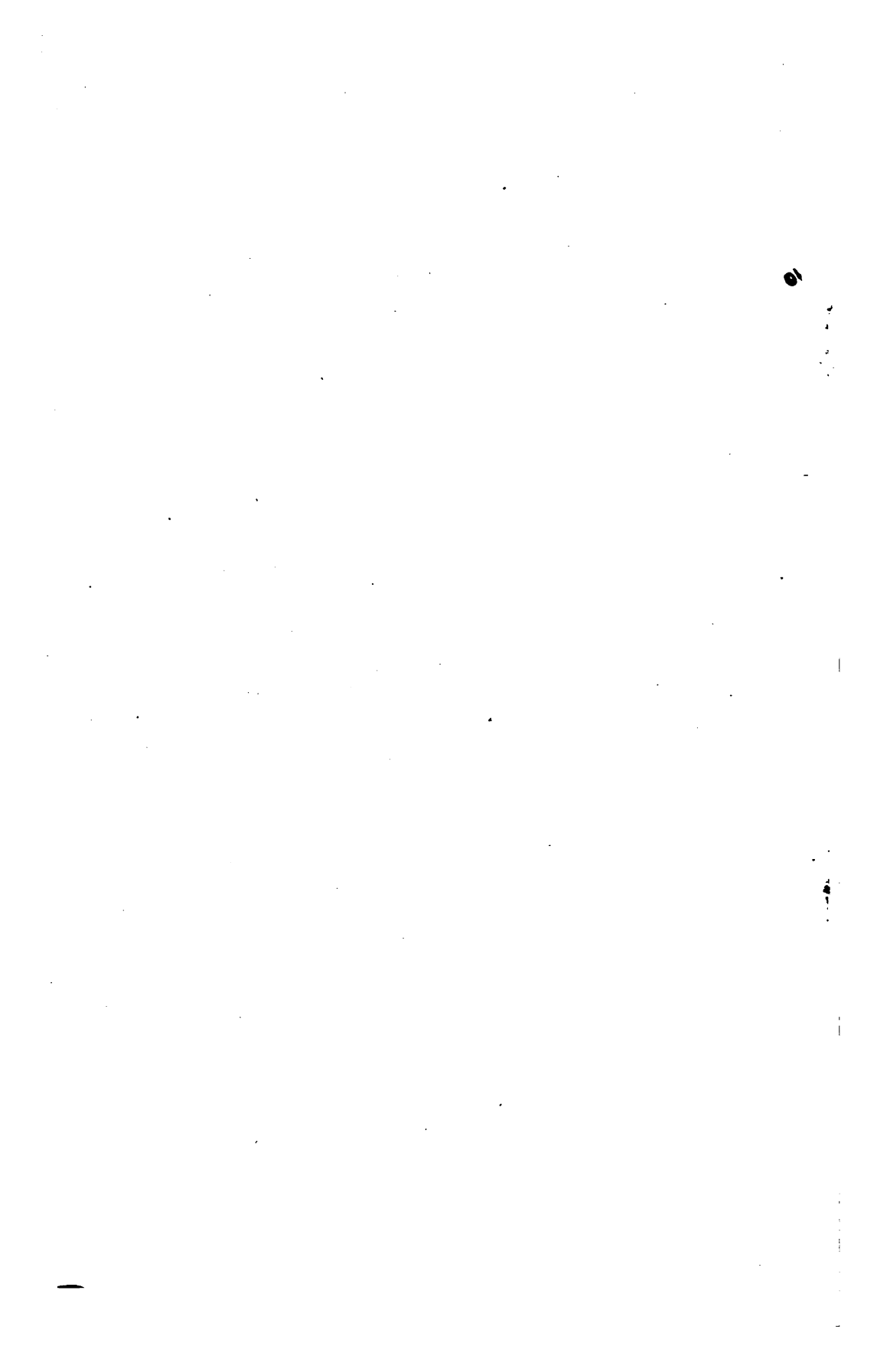
Number of trees per acre.

Hardy Catalpa.....	680
Black Walnut	680
Black Locust.....	680
Russian Mulberry.....	680

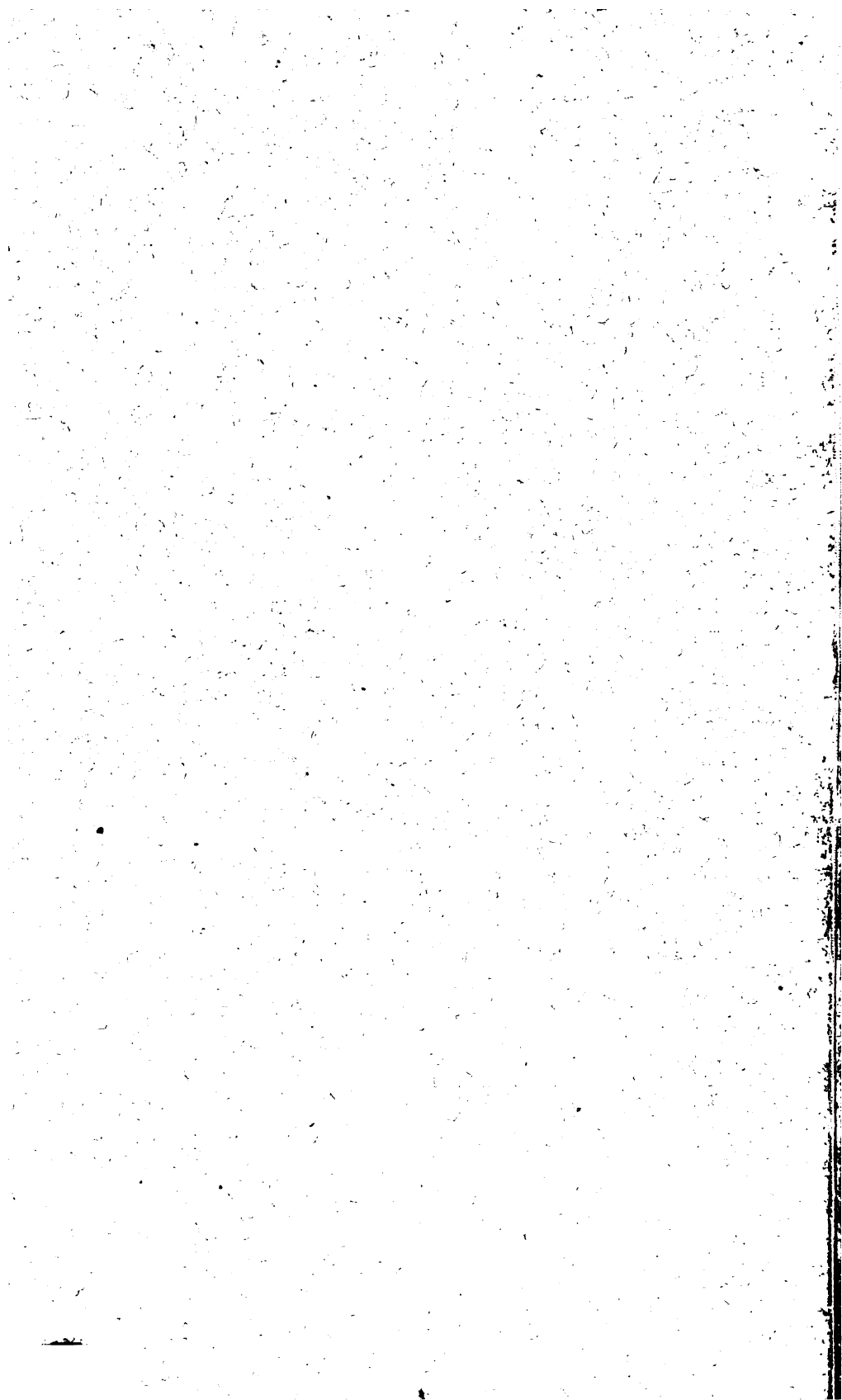
EXPLANATION OF PLAN.

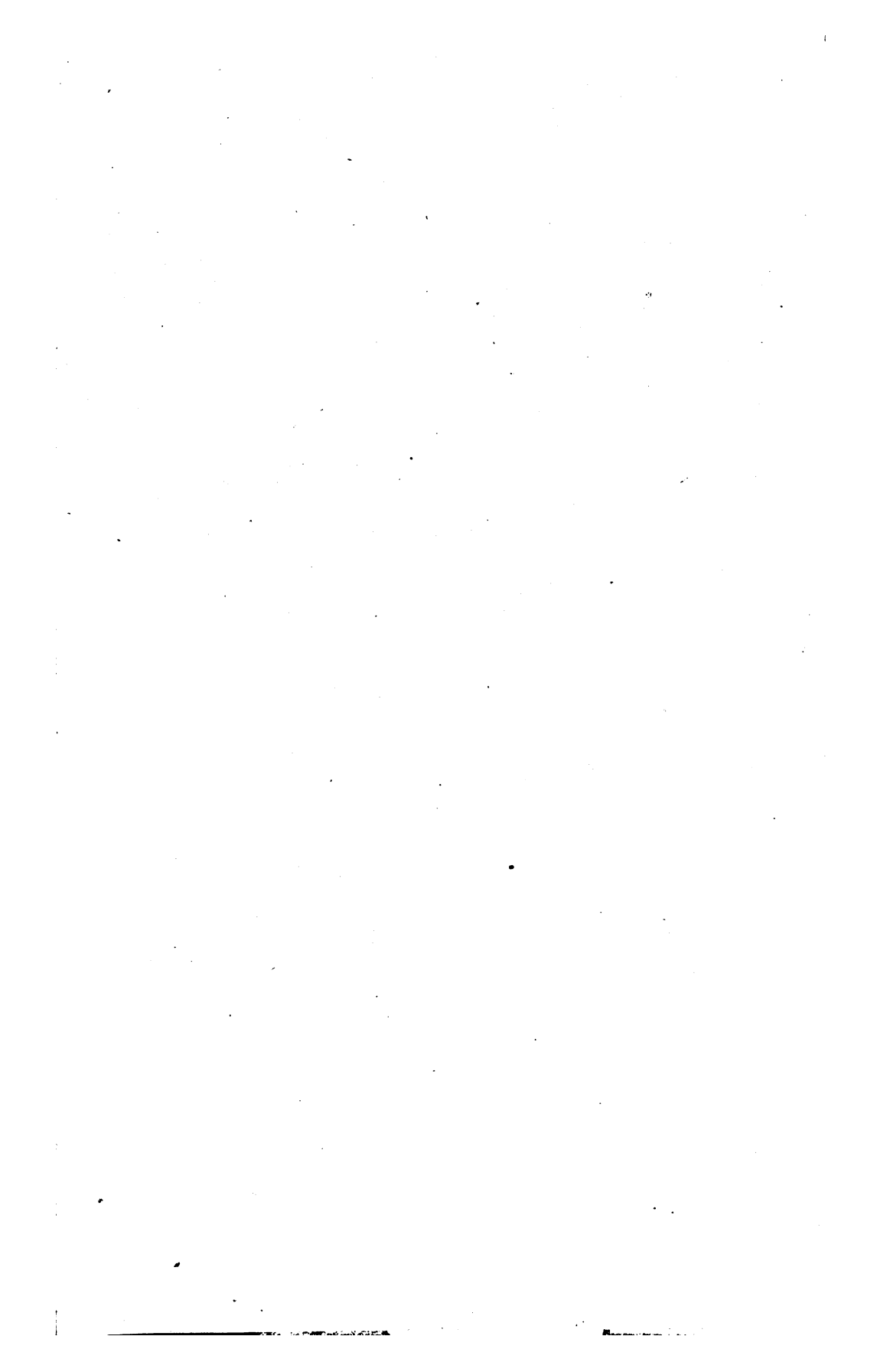
The plan proposes Hardy Catalpa, Black Locust, Black Walnut, and Russian Mulberry in equal proportions, planted 4 feet apart each way. In the first row the Catalpa and Walnut alternate, in the second row the Locust and Mulberry alternate, and this order continues throughout the plantation. As the object of the plantation is, first, the production of durable material for posts and poles, and, second, a forest of valuable trees, it is designed that the larger proportion of the Mulberry and Catalpa be removed as soon as they are large enough to be utilized. When the trees begin to crowd again the Locust is to be removed, ultimately leaving the Walnut as the permanent forest growth, with a sufficient number of Mulberry and Catalpa to insure the requisite cover.

If impracticable to plant the entire plat in the spring of 1900, the planting may be extended over two or more seasons, until the whole tract is planted.



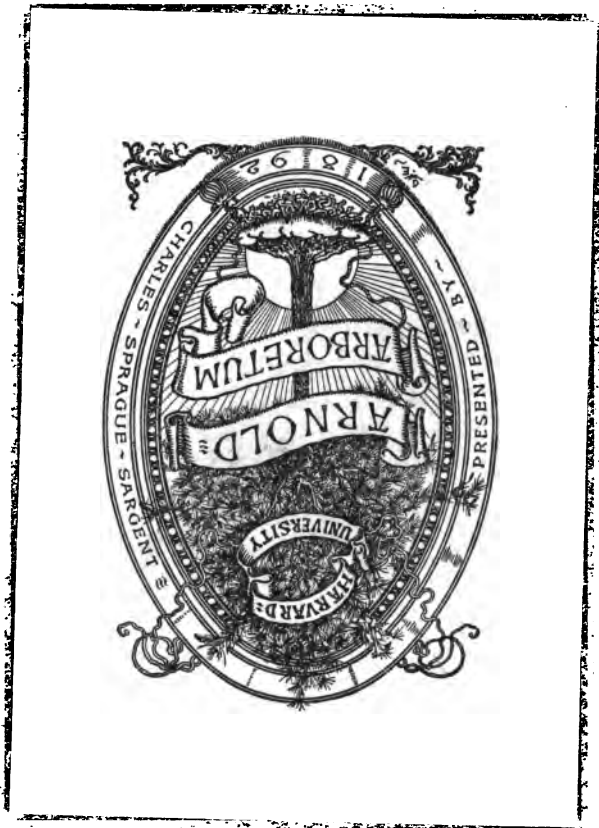








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U. HOLZER
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